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DRAWINGS ATTACHED

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(19)

(54) IMPROVEMENTS IN GLAZING ASSEMBLIES

(71) We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, of Imperial Chemical House, Millbank, London, S.W.1, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to double glazing systems, and particularly to assemblies for the conversion of windows from single glazing to double glazing.

Our patent No. 1,264,307 relates to assemblies for the conversion of a single-glazed window to double glazing or a single window to a double window, which comprise an edge strip and a sheet of glazing material, said edge strip having a base web and a flange extending substantially perpendicularly out of and longitudinally along the base web, at least one marginal portion of the sheet of glazing material being bonded to said flange and web. The glazing material may be bonded to the edge strip by any suitable adhesive material such as polyvinyl butyral, polysulphides, polyacetals, epoxy resins and copolymers of ethylene with one or more hydroxy or epoxy lower aliphatic monoesters of acrylic acid or of methacrylic acid and a further comonomer such as an acrylic or methacrylic ester or a vinyl ester. We have now found that by replacing the hydroxy or epoxy lower aliphatic monoesters of the copolymer by methacrylic acid, a composition is produced which is potentially cheaper while still retaining adhesive properties which render it suitable for bonding the sheet of glazing material to the edge strip.

Therefore, according to the present invention we provide an assembly for the conversion of a single-glazed window to double glazing or a single window to a double window, which comprises an edge strip and a sheet of glazing material, said edge strip having a base web and a flange extending substantially perpendicularly out of and longitudinally along the base web, at least one marginal portion of the sheet of glazing material being bonded to said flange and web, in which assembly the adhesive material employed to bond the sheet of glazing material to the edge strip contains as the adhesive-providing component a copolymer consisting of, by weight of the copolymer, from 50% to 93% of ethylene, from 2% to 40% of methacrylic acid, from 5% to 48% in total of one or more vinyl, acrylic or methacrylic esters, and from 0% to 15% of styrene.

The vinyl ester component of the copolymer preferably has the formula

$$RCOOH=CH_2$$

wherein R is an alkyl radical having from 1 to 5 carbon atoms and is conveniently vinyl acetate. The acrylic or methacrylic esters are preferably alkyl esters in which the alkyl radical has 1 to 8 carbon atoms, suitable esters including methyl acrylate, ethyl acrylate, butyl acrylate, ethyl hexyl acrylate and methyl methacrylate. The adhesive composition preferably has a melt flow index not greater than 20 as measured according to B S 2782: part 1: 1965—method 105 C.

It is generally preferred that the copolymer contains by weight, from 5% to 25% of methacrylic acid. Amounts less than 5% by weight may give insufficient adhesion to the glazing material and/or the edge strip where for example the glazing material is bonded to the web and only a single flange, while amounts above 25% by weight provide little further advantage and add to the cost of the assembly. An amount of from 7% to 35% by weight of the ester is usually preferred, the actual amount of ester employed being selected to give the desired flexibility in the adhesive material. Increasing the proportion of ester in the copolymer increases the flexibility of the adhesive material.

The proportions of the comonomers employed to produce the adhesive material will be selected according to the desired properties that the material is to have. In addition to flexibility the material should also

have an acceptable degree of flowability in its molten form to facilitate the flow of the material during the bonding process which is described hereinafter. Thus a material having a low melt flow index has poor flow properties during bonding. A material of high melt flow index may have a poor bond strength to the glazing material and/or the edge strip. For this reason materials having a melt flow index of 2 to 10, and conveniently from 4 to 6, are preferred. Suitable materials therefore most preferably contain, by weight from, 10% to 20% of methacrylic acid and 10% to 30% of ester. For instance, a copolymer containing, by weight, 15% of methacrylic acid and 20% of vinyl acetate and having a melt flow index of 5.0 is suitable for use as the adhesive material.

The adhesive material may include any suitable additives, such as fillers, stabilisers, pigments and plasticisers.

The adhesive material may also be produced as a blend of the ethylene copolymer with other compatible thermoplastics materials such as ethylene/vinyl acetate copolymers, and copolymers of ethylene with lower alkyl esters of acrylic or methacrylic acid, e.g. methyl acrylate, ethyl acrylate, butyl acrylate and methyl methacrylate, the proportion of the blended thermoplastics material being possibly as high as 70% by weight of the adhesive material. The proportion of the blended thermoplastics material is generally chosen so as to produce an adhesive material having a melt flow index within the range specified above.

The proportions of a particular comonomer or comonomers giving, with the ethylene, an optimum balance of properties, are therefore determined by experiment. It will be appreciated that it is a matter of ordinary scientific skill to match these copolymers by varying the combination and proportions of the comonomers present in the copolymer, within the limits set out hereinbefore.

It has been found that the adhesive material has a satisfactory moisture resistance. For instance, it is largely unaffected by 2 hours' immersion in boiling water or by exposure to 100% relative humidity at 50°C for 14 days.

The assembly itself is constructed so that the edge strip is positioned around all or only some of the edges of the assembly.

The assembly may be affixed over the glazing material of a fixed or opening window frame, generally by affixing the assembly to the frame carrying the glazing material. This provides a sealed space between the existing glazing in the window frame and the sheet of glazing material of the converting assembly which serves as a double glazing and possibly also as an acoustic unit.

Alternatively, the converting assembly may be affixed to the surrounding fixed frame, in which an opening window frame casement is mounted, thereby not only providing a sealed space between the existing glazing in the opening frame and the sheet of glazing material of the converting assembly to act as a double glazing and/or acoustic unit but also serving to seal the window unit against the ingress of draughts between the fixed and opening frames. For optimum effect the converting assembly should be efficiently sealed against the fixed frame.

As a modification of the system discussed in the last preceding paragraph the converting assembly may be attached to the window surround, i.e. the plaster or brickwork defining the window aperture and surrounding the window frame mounted therein. A mounting strip may be provided in the surround for mounting the converting assembly upon. This mounting strip may be a metal or plastics extrusion. This construction also provides a seal against the ingress of draughts.

The assembly may be permanently attached to the window frame in constructions where it would not impede the movement of an opening frame, e.g. it may be affixed to an opening frame itself or to a fixed frame not involving an opening window, to form a sealed space between the existing glazing in the window frame and the sheet of glazing material of the converting assembly may be affixed to the window frame so that it is detachable or so that all of the sides of the assembly except for one side can be released from the frame, the remaining side being hinged to the frame, thereby enabling the inner surfaces of the existing glazing in the frame and the glazing material of the assembly, i.e. the surfaces of the existing glazing and the glazing material confronting the space therebetween, to be cleaned by pivoting the assembly away from the frame. Also, in the case where the converting assembly is affixed to the fixed frame in which an opening frame is mounted, the assembly may be pivoted away from the fixed frame to enable the opening frame to be opened in the normal way thereby providing for ventilation through the system.

Preferably a hinge made, for example, of metal or a plastics material, is secured to the edge strip along one side of the assembly by bonding, screwing or riveting. The hinge is attached to one side of the frame whilst the remaining sides of the assembly are secured to the other sides of the frame by means of readily releasable clips, which may be snap clips, e.g. consisting of moulded plastics material such as nylon, or a polyacetal or clips which may be mechanically adjusted into engagement with the frame or members attached to the frame. It is possible to use clips of a more permanent nature than snap clips and adjustable clips, e.g. clips

which may be screwed or bolted to the frame. However, clips of this nature require more tedious manipulation than do the more readily releasable clips in order to release the assembly from the frame. Therefore, we prefer to use readily releasable clips. The edge strip may be formed with a peripheral ridge protruding out of the base web, the clips being arranged to engage the ridge. If desired a continuous bead may be clamped over the ridge and drawn into engagement with it by the clips.

One embodiment employs hinges along two opposite sides of the converting assembly, one part of each hinge being attached to the edge strip, e.g. by riveting, and the other part being attached to the window frame, e.g. by screwing. The two parts of the hinge are held together by a pivot pin which may be withdrawn to separate the two parts. To pivot the converting assembly away from the window frame the pins are withdrawn from the hinges along one side of the converting assembly so that the assembly can be swung away from the window frame whilst pivoting about the hinges along the opposite side. By using hinges in which the pivot pins can be withdrawn the hinge can serve to provide a true hinging function between the converting assembly and the window frame and also as a releasable clip when the pivot pin is removed. It will be appreciated that the dual functions of the hinges enables a converting assembly hung on these hinges to be pivoted about any one of its sides chosen at will or to be removed from the window frame altogether by removing the pivot pins from every hinge.

In an alternative embodiment, an edge bead is constructed so that it may perform two functions in securing the assembly to the frame by engaging the edge of the assembly or the edge strip; firstly it is formed to serve as a hinge, and secondly it is formed so that it may be separated into two parts. Accordingly, such an edge bead may be arranged around the whole periphery of the assembly with the advantage that the assembly may be hinged away from the frame about the edge bead attached to any one side of the assembly after the edge bead along each of the other sides has been separated into two parts.

In order that the space between the existing glazing and the glazing material of the assembly according to the invention may be efficiently enclosed, a sealing strip is preferably attached around the whole periphery of the assembly. When the edge strip extends around all of the edges of the assembly the sealing strip may be attached to the edge strip. The sealing strip should be attached to the asssembly so that it faces the window frame and will be compressed to prevent the passage of air between itself and the frame or surround when the assembly is clipped on to the frame or surround. Suitable materials from which the sealing strip may be made include foamed plastics materials, rubbers or foamed rubbers, such as polymers based on chloroprene, e.g. neoprene and the woven fabric piles. The sealing strip may be secured in place by any suitable adhesive, such as natural rubbers or synthetic rubbers e.g. butadiene or chloroprene based rubbers in solvents such as chlorinated hydrocarbons or petroleum ethers, and epoxy resins.

The edge strip may be made of any suitable material, e.g. metals, such as aluminium or stainless steel, and synthetic plastics materials, such as glass reinforced polyester, nylon or glass reinforced nylon, vinyl chloride polymers, polyacetal and polymethyl methacrylate. We prefer to use extruded aluminium sections as the edge strip.

The sheet of glazing material may comprise glass or a transparent or translucent plastics material, such as polymethyl methacrylate or a vinyl chloride polymer.

When the glazing material is glass, the adhesion between the glass and the adhesive material may be improved by applying an adhesion promoting agent to the glass surfaces and/or the adhesive composition surfaces which are to be bonded together prior to assembling the sheet and plastics material.

The adhesion promoting agent is advantageously a compound having functional groups which will couple with a functional group of the adhesive composition and is also capable of forming a chemical linkage with the glass surface. Silanes are our preferred adhesion promoting agents, particularly vinyl silanes, epoxy silanes, amino silanes, triethoxy silanes and trimethoxy silanes such as vinyl trichlorosilane, γ - aminopropyltriethoxy silane, vinyl triethoxy silane, methyl triethoxy silane, vinyl triacetoxy silane, ethyl-aminochlorosilane, γ - glycidoxy propyltriethoxy silane, methacryloxy silane, vinyl trimethoxy silane and methyl trimethoxy silane.

The adhesion promoting agent may be applied to the glass surface and/or in some circumstances the adhesive material, e.g. when a bead or strip of the aforesaid ethylene copolymers is used, in the form of a solution which may consist of the undiluted adhesion promoting agent when it is a liquid or of the adhesion promoting agent in aqueous solution or dispersion or in an organic solvent, preferably one of low boiling point such as petroleum ether, toluene, benzene or xylene. Alternatively, when the adhesion promoting agent is readily vaporisable it may be applied to the glass surface and/or the adhesive composition as a vapour.

In general it is most convenient to use a liquid adhesion promoting agent, such as methyl triethoxy silane, and this may be

applied by brushing, spraying or wiping the liquid over the surface to which it is to be applied.

Both the surface of the glass and the adhesive material may be wetted with the adhesion promoting agent; if desired this may conveniently be accomplished by applying a coating of the adhesion promoting agent to the surface of the adhesive material only and then bringing the glass and coated adhesive material surfaces together whereupon the glass is wetted by the adhesion promoting agent.

It has been found that a satisfactory degree of adhesion between a glass surface and the adhesive material can be achieved when vinyl or methyl triethoxysilane is used as an adhesion promoting agent. This may be applied to the surfaces to be bonded in the manner described in the last preceding paragraph.

The assembled converting assembly may be bonded together by any suitable method depending upon the properties of the materials from which the edge strip and the glazing material are made. This process is effected by heating the assembly until the adhesive material becomes molten and is able to flow in the space between the edge strip and the glazing material. Bonding is effected when the adhesive material solidifies. The heating step may be effected in an environment maintained at temperatures above 110°C and as high as about 200°C. For example, the adhesive material would normally be sufficiently molten for bonding by heating at a temperature in the region of 200°C for about two minutes. It will be appreciated that the temperature and time cycle of the bonding process may be varied as required, a lower temperature requiring a longer heating time to melt the adhesive material than a higher temperature.

In order that the present invention may be more readily understood, two preferred embodiments thereof are now described by way of example only and with reference to the drawings accompanying the provisional specification, in which:

Figure 1 is a cross-section taken horizontally through an opening window frame and a fixed window frame on which an assembly according to the invention is mounted.

Figure 2 is an exploded perspective view of a hinge as shown in Figure 1; and

Figure 3 is a cross-section through a window showing an assembly according to the invention secured in the window surround.

Figure 1 shows a cross-section taken horizontally through a window assembly. A fixed window frame has two vertical wooden side members 65 and 66 which are affixed directly in the window surround (not shown) of a building wall. An opening fanlight window consisting of wooden side members 67 and 68 provided with a single sheet of glass 69 is mounted in the fixed frame and hinges about an axis perpendicular to the side members 65 and 66. An assembly according to the invention is shown at 70. This comprises a sheet of glass 72 and an extruded aluminium edge strip 73 bonded around all of the edges of the glass sheet. The edge strip has a base web 74 and two spaced apart flanges 76 and 77 extending substantially perpendicularly inwardly from the base web 74 and longitudinally along the base web. Each flange has an inwardly projecting rim 78 serving to position the edge of the glass sheet in the strip 73. A small ridge 79 projects inwardly from each flange 76 and 77 serving to limit the extent to which the edge of the glass sheet 72 may project inside the strip 73, thereby providing space between the edge of the glass sheet 72 and the base web 74 to accommodate screws and rivets used to attach components to the base web 74. The edge of the glass sheet 72 is bonded between the flanges 76 and 77 by a synthetic plastic adhesive material comprising, by weight, ethylene 65%, methacrylic acid 15% and vinyl acetate 20%.

The assembly 70 is produced by positioning an extruded bead of the adhesive composition treated on its surface with methyl triethoxysilane adhesion promoting agent inside a length of the edge strip 73 sufficient to extend around the whole perimeter of the glass sheet 72. The edge strip 73 and the bead of adhesive composition are heated at a temperature in the region of 180°C for about 2 minutes to melt the adhesive material. The strip 73 is then located around the edges of the glass sheet 72 and the assembly clamped together whilst the composition is cooling to form a bond between the glass and the edge strip 72.

A foamed neoprene sealing strip 81 is bonded by an adhesive formed from a chloroprene rubber in methylene chloride as solvent to the flange 77 and the section of the base web 74 between the flange 77 and the frame. The sealing strip 81 is slightly deeper than this section of the base web 74 so that it is compressed between the frame and the base web 74 thereby forming a seal between the frame and the assembly 70.

The assembly 70 is attached to the frame by hinges 82 and 83 screwed to the members 65 and 66 respectively and riveted to the base webs 74. The hinges 82 and 83 have the construction shown in exploded form in Figure 2. The hinge is composed of two parts 85 and 86, each identical mouldings of nylon. The parts 85 and 86, as shown in part 86, have a base 87 from which two upstands 88 and 89 project, a space 90 corresponding to the length of the upstand 88 being located between the upstands 88 and 89 and a space 91 corresponding to the

length of the upstand 89 being located between the upstand 88 and the end of the base 87. Aligned bores 92 and 93 having diameters corresponding to that of a pivot pin 94 extend through the upstands 88 and 89. The hinge may be assembled by reversing the parts 85 and 86 and bringing them together so that the upstands 95 and 96 on the part 85 are located in the spaces 91 and 90 respectively on the part 86. The pivot pin 94 is then inserted through the bores 92 and 93 and the corresponding bores 97 and 98 in the part 85 to lock the two parts together whilst permitting the parts to pivot about the pin. Countersunk screw holes 99 are provided in the bases 87 of each of the parts for attaching the hinge to the assembly and to the frame.

The assembly is affixed to the fixed window frame by affixing the two separate parts of each hinge to the frame sidemembers and to the assembly individually. In the embodiment shown in Figure 1 two hinges are attached to each of the side members 65 and 66, only the upper hinges 82 and 83 being visible. One part of each hinge is attached to the respective side member by driving screws through the holes 99 into the side member and the other part of the hinge is attached by riveting to the assembly in a position corresponding to that of the first part on the side member. The assembly is then positioned against the frame by inter-engaging the upstands and intervening spaces of the corresponding parts of each hinge and inserting the pivot pin through the bores in the upstands thereby locking the two parts together and also the assembly to the fixed window frame. The assembly may be opened to allow access to the fanlight for cleaning or to open it for ventilation by removing the pivot pins from the hinges attached to one side member, e.g. the hinge 82 and the hinge affixed to the member 65 below the hinge 82. Removal of the pivot pins permits the two parts of the hinges to be separated thereby allowing the assembly to pivot about the hinges attached to the side member 66 such as the hinge 83. The assembly may be removed altogether from the fixed window frame by withdrawing the pivot pins from all of the hinges thereby permitting the two parts of each hinge to be separated.

In a modification of the embodiment shown in Figure 1, the assembly is affixed to the window frame by means of hinges attached to one side member and snap clips securing the opposing side of the assembly to the corresponding side member of the frame.

Figure 3 shows a brick surround 101 to a window aperture in which a fixed wooden frame 102 carrying a single glass sheet 103 is mounted. A strip 104 of rigid polyvinyl chloride is screwed by screws 105 to the surface of the surround 101 on the internal side of the window frame 102. An assembly 106 according to the invention and similar in construction to the assembly 70 shown in Figure 1 is secured to the strip 104 by hinges 107 having the construction shown in Figure 2. The assembly may be pivoted away from the frame by removing the pivot pins from the hinges along one side of the assembly and pivoting the assembly on the hinges along the facing side of the assembly.

Although Figure 3 shows the frame 102 as a fixed frame it is to be understood that this embodiment may be employed with a modification in which a single glazed opening window frame is mounted in a fixed frame which is secured in the window surround 101, i.e. the manner of mounting the assembly in Figure 3 may be used for a fixed or opening window.

Instead of mounting the assembly on the strip 104 attached to the inside of the surround 101, the strips may be attached to the inner surface 110 of the surround and the assembly 106 mounted on the strip 104.

A further modification to this embodiment consists in attaching the assembly to the strip 104 by means of hinges attached to the strip 104 extending along one side of the window aperture and snap clips fastening the opposing side of the assembly to the strip extending along the opposite side of the window aperture.

WHAT WE CLAIM IS:—

1. An assembly for the conversion of a single-glazed window to double glazing or a single window to a double window, which comprises an edge strip and a sheet of glazing material, said edge strip having a base web and at least one flange extending substantially perpendicularly out of and longitudinally along the base web, at least one marginal portion of the sheet of glazing material being bonded to said flange and web, in which assembly the adhesive material employed to bond the sheet of glazing material to the edge strip contains as the adhesion-providing component a copolymer consisting of, by weight of the copolymer, from 50% to 93% of ethylene, from 2% to 40% of methacrylic acid, from 5% to 48% in total of one or more vinyl, acrylic or methacrylic esters, and from 0% to 15% of styrene.

2. An assembly according to claim 1 in which the ester of the copolymer is a vinyl ester having the formula

$$RCOOH=CH_2$$

wherein R is an alkyl radical having from 1 to 5 carbon atoms.

3. An assembly according to claim 1 in which the ester of the copolymer is selected from acrylic and methacrylic alkyl esters in which the alkyl radical has from 1 to 8 carbon atoms.

4. An assembly according to any one of claims 1 to 3 in which the copolymer contains from 5% to 25% by weight of methacrylic acid.

5. An assembly according to any one of claims 1 to 4 in which the copolymer contains from 7% to 35% by weight of the ester.

6. An assembly according to any one of claims 1 to 5 in which the copolymer has a melt flow index not greater than 20.

7. An assembly according to claim 6 in which the copolymer has a melt flow index of from 2 to 10.

8. An assembly according to claim 7 in which the copolymer has a melt flow index of from 4 to 6.

9. An assembly substantially as hereinbefore described with reference to the drawings.

C. GRATWICK,
Agent for the Applicants.

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1337541 PROVISIONAL SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

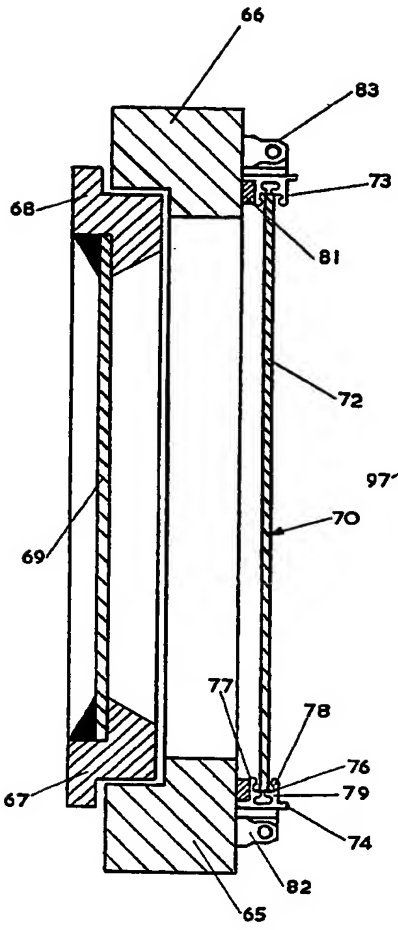

FIG 1

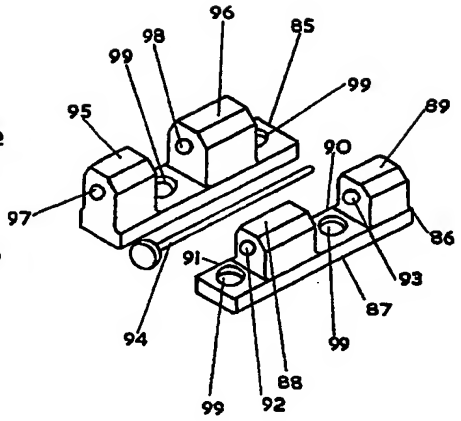

FIG 2

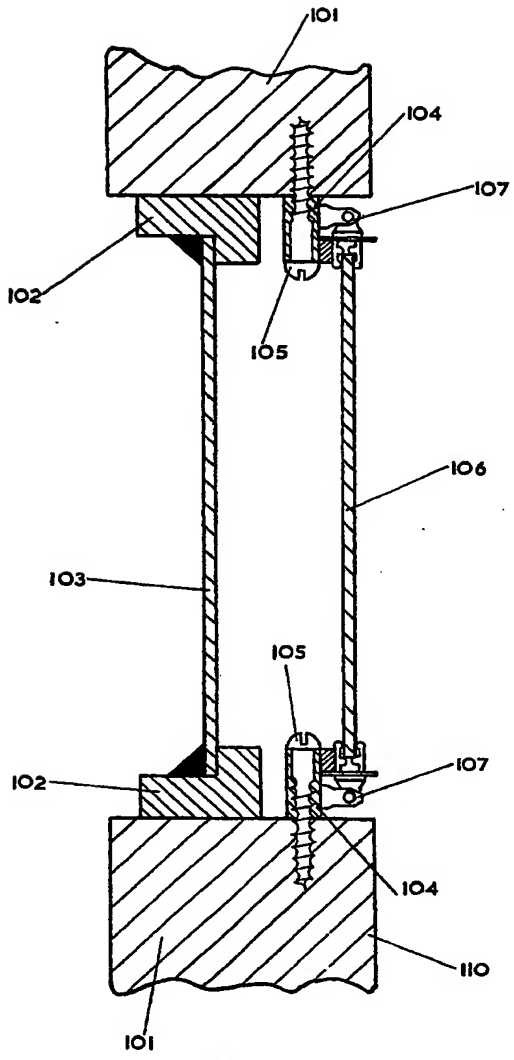

FIG 3